# UEF Feedback session: “User Voice Corner”


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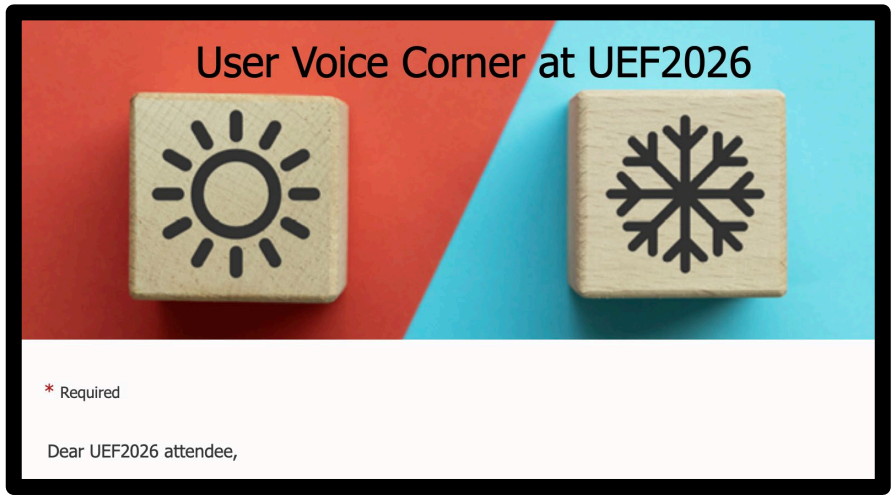
# Background

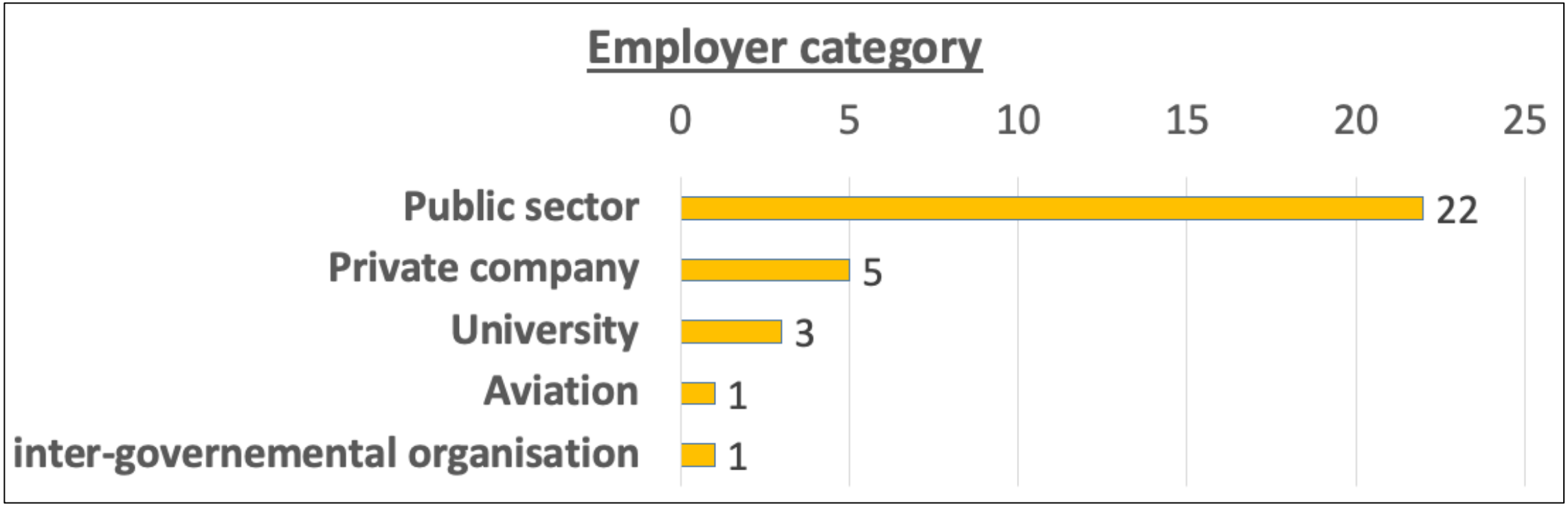
- Earlier this year (prior to the introduction of cycles 50r1 and AIFS V2s) ECMWF circulated to users a feedback survey
- This session relates to that survey, and is divided into two parts:
  1. Presentation of the results in seminar format (25 mins), and
  2. Breakout groups where topics of particular interest / current relevance can be interactively discussed with ECMWF staff (70 mins)
- Breakout group arrangements will be discussed at the end of the seminar



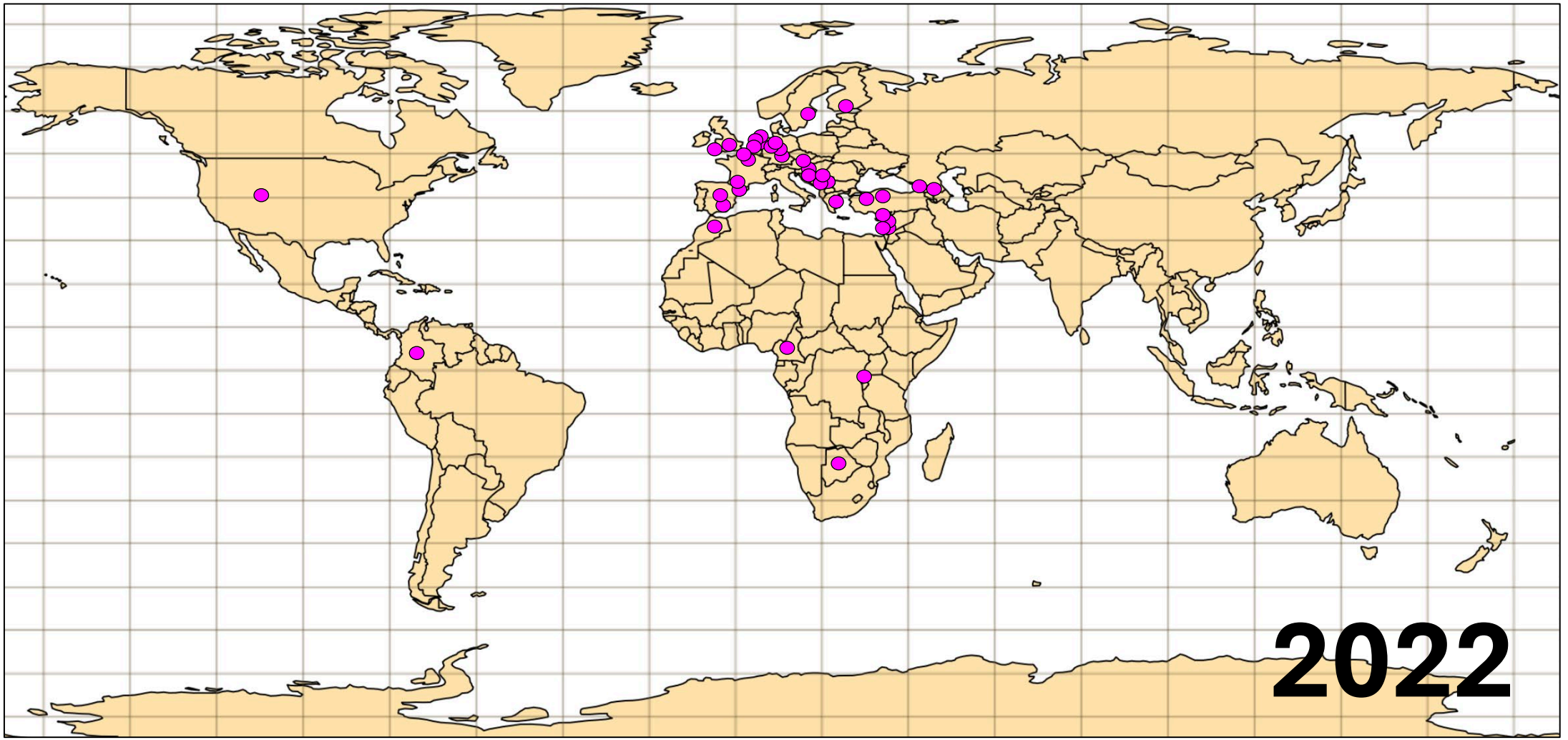
# Survey Results

- Will be presented broadly in line with the survey questions
- The questions themselves will often be “paraphrased” for brevity
- One or two examples from the ECMWF side will be included
  - Although the survey invited graphical examples, few were provided
- Sub-sections:
  1. Employer class
  2. Affiliation location
  3. Main product interests
  4. Forecast problems encountered
  5. Good forecasts encountered
  6. 2m Temperature Extremes
  7. AI Models
  8. The transition to GRIB2
  9. Miscellaneous comments
  10. Examples

# 1. Employer classes



# Name and Affiliation… : Where are survey responders based?



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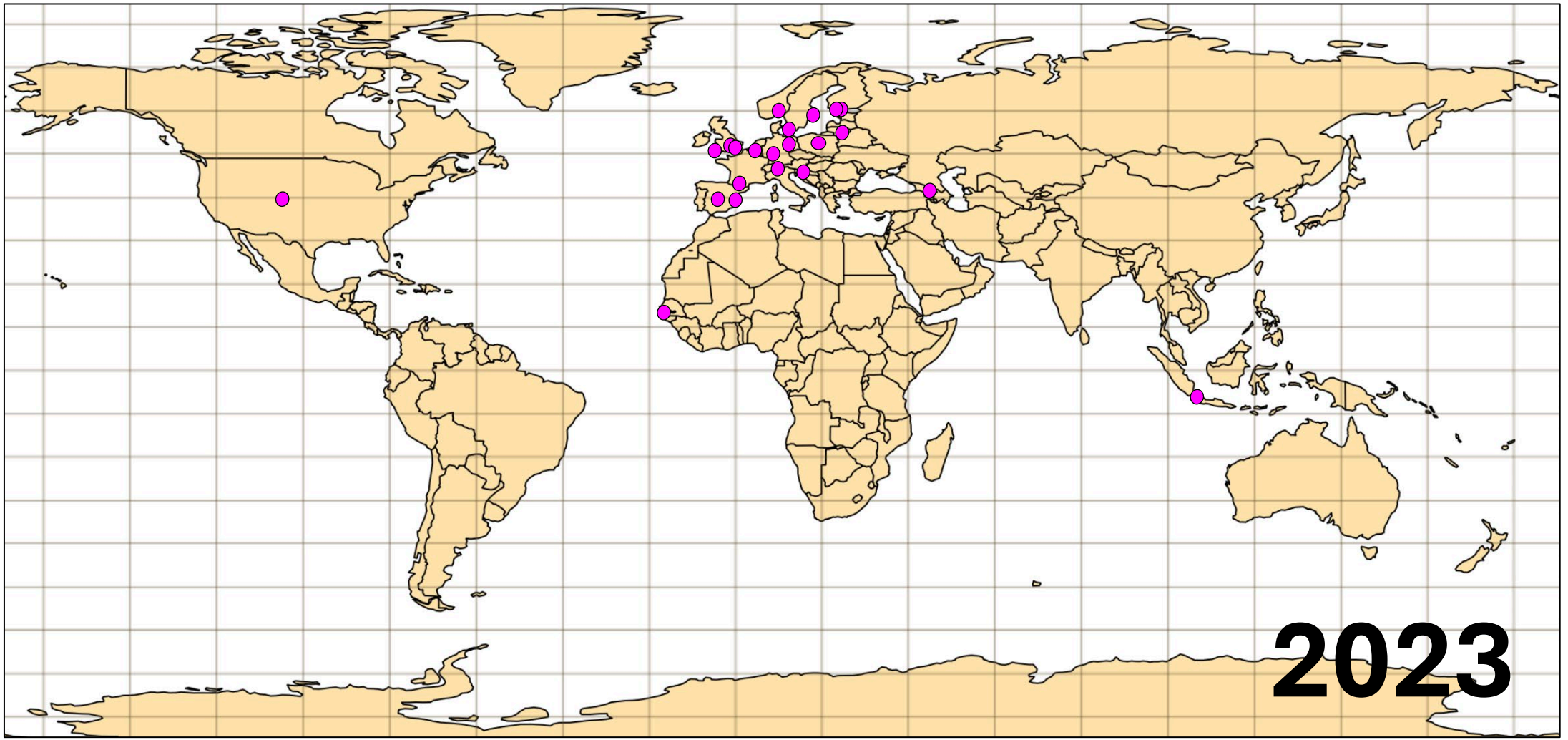

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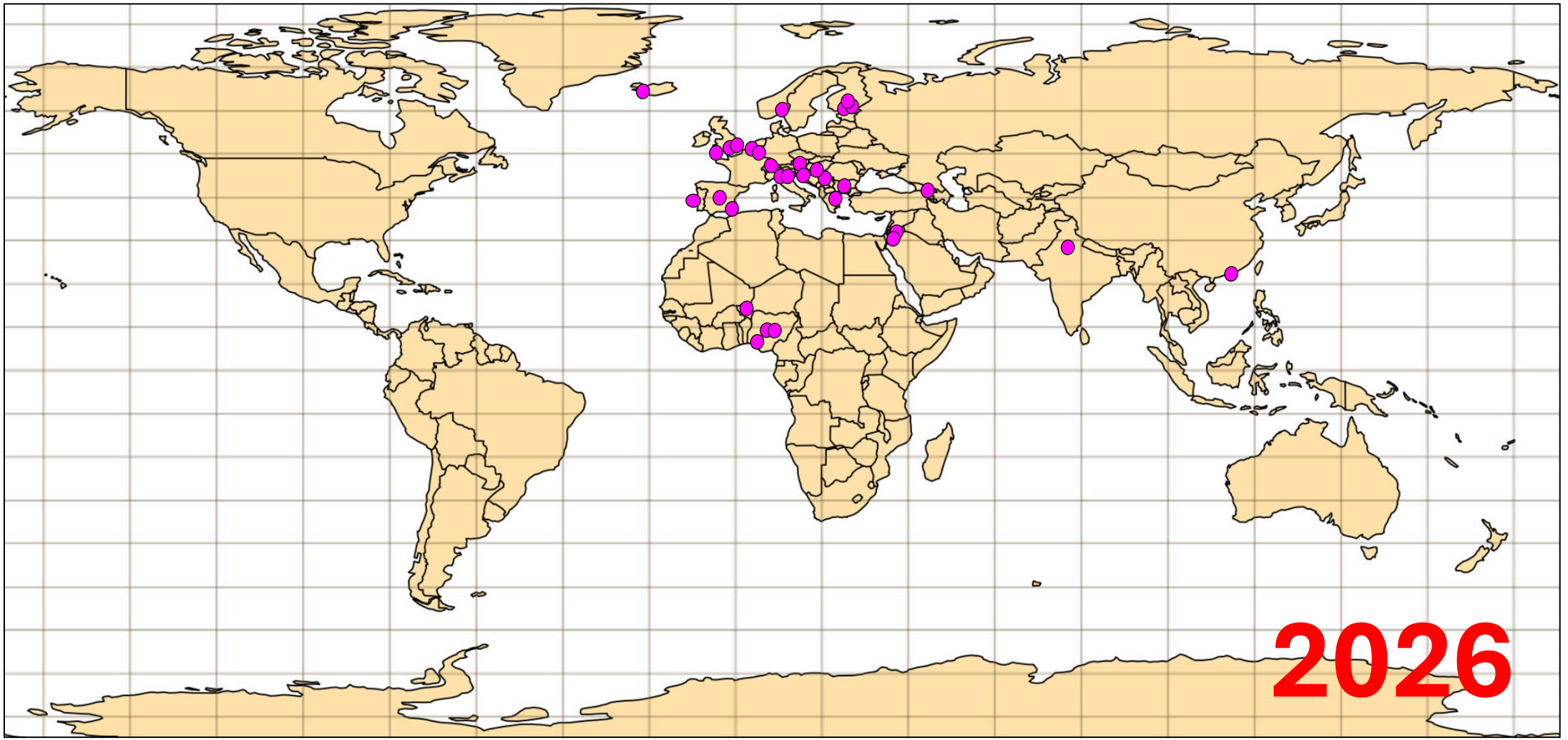


# 3. Forecasting aspects of most concern / relevance

- Temperature extremes
- Precipitation amount/type
- Convection/lightning
- Cloud/fog
- Wind
- Severe weather


- Recurring themes were
  - The need to better capture local effects
  - Issues related to complex terrain
  - Coastal influences
  - Longer-range uncertainty

# 4. Forecast Problems experienced in the last 18 months

- Biases in minimum/maximum temperatures, especially related to:
  - Inversions
  - Radiative nights
  - Snow cover
  - Complex terrain
- Cloud/low-cloud issues
- Convective precipitation/lightning:
  - Unrealistic localised maxima
  - Poor placement
  - Underestimation
- Medium-range consistency issues
- Desire to see better performance / signals at sub-seasonal lead times

Resolution

Model Physics

Post-processing

Observations

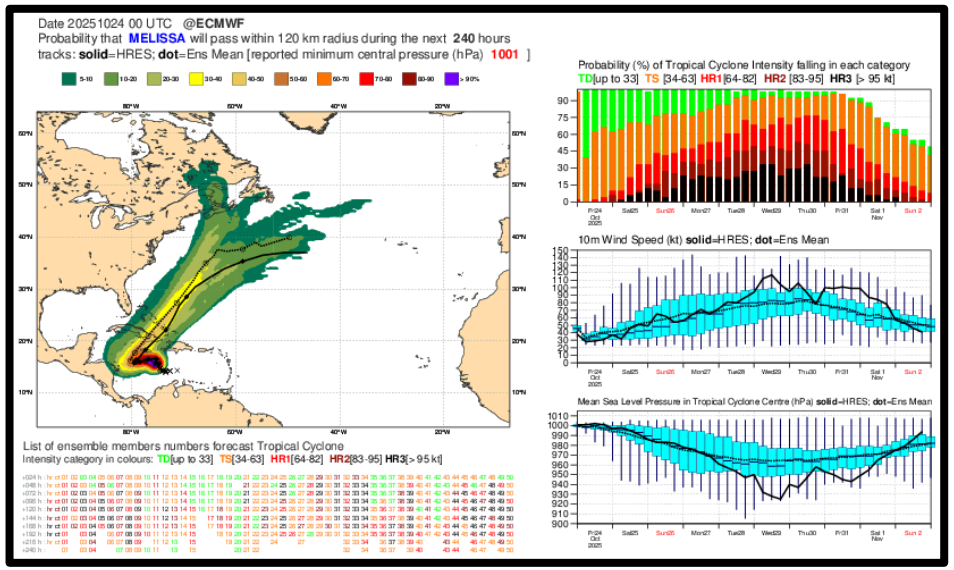
*“ Near coast / high ground convective precipitation is overdone ”*
*(50r1 fix)*

*“ Fraction of wet snow can be too high ”*

# 5. Notably Good forecasts in the last 18 months

- Positive examples included:
  - Improved fog/low-cloud forecasting
  - Useful EFI/ensemble products
  - Handling of some storms
  - Tropical cyclone tracks
  - Floods
  - Winter weather cases

- Praise in general terms for:
  - Synoptic-scale forecast guidance
  - Ensemble guidance

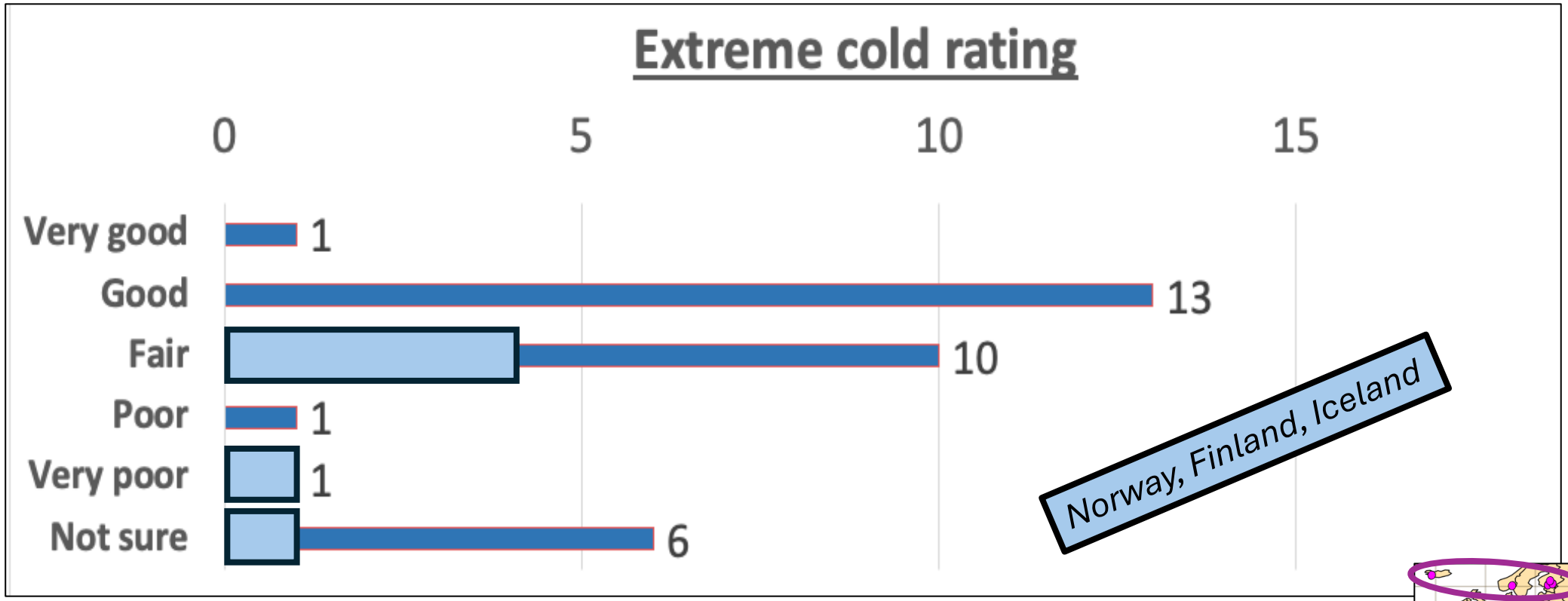


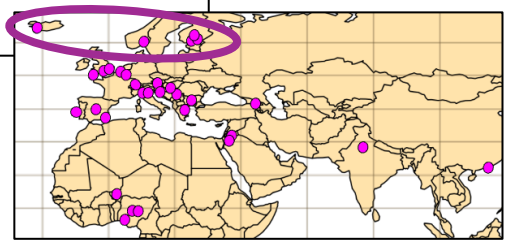
# 6. 2m Temperature Extremes

*Theme of the meeting ☺*

# “How good is ECMWF at forecasting Extreme temperatures ?”

*paraphrased*



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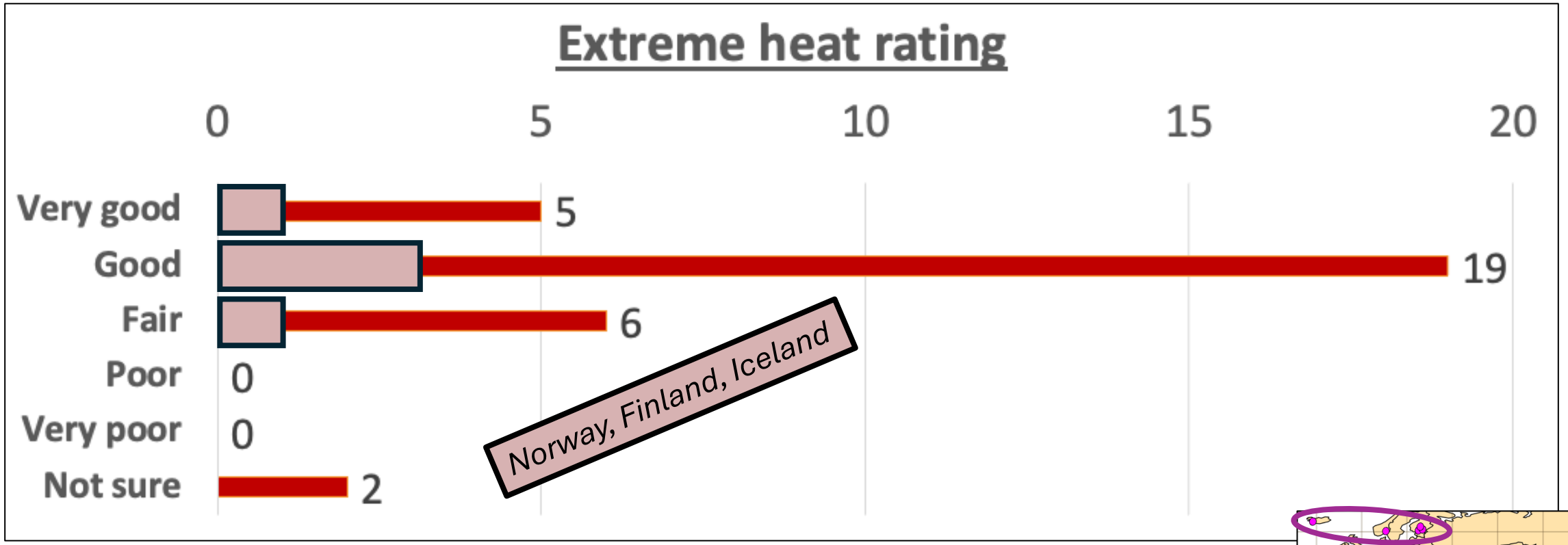
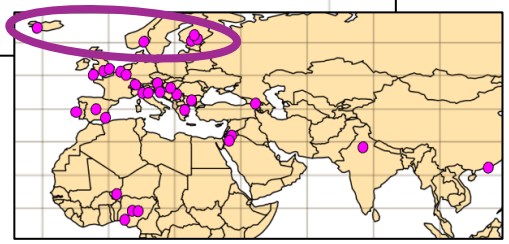
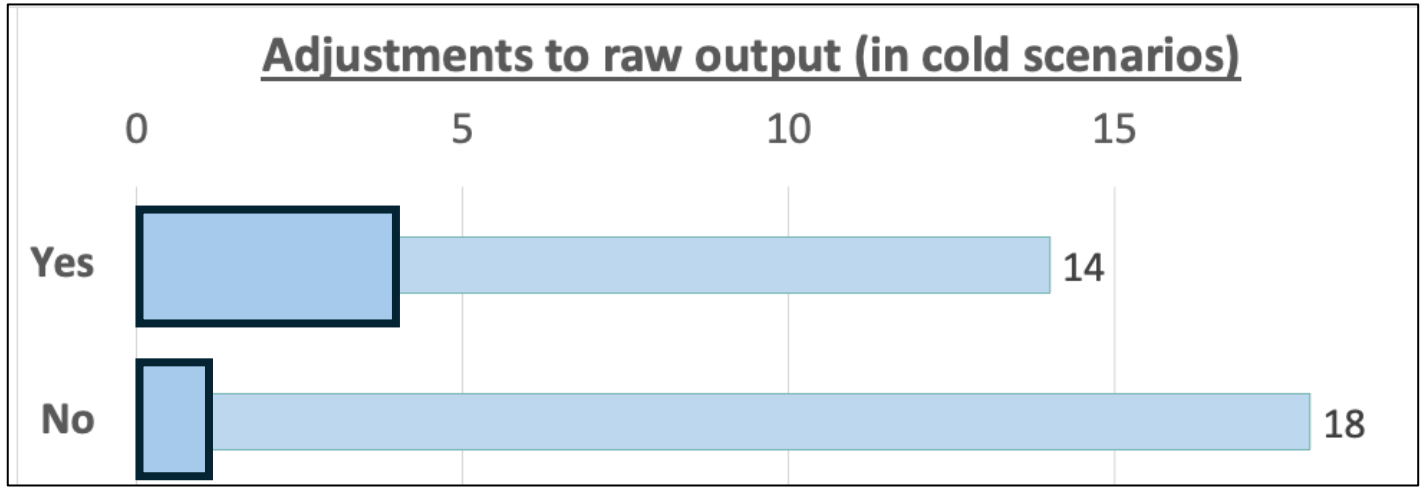


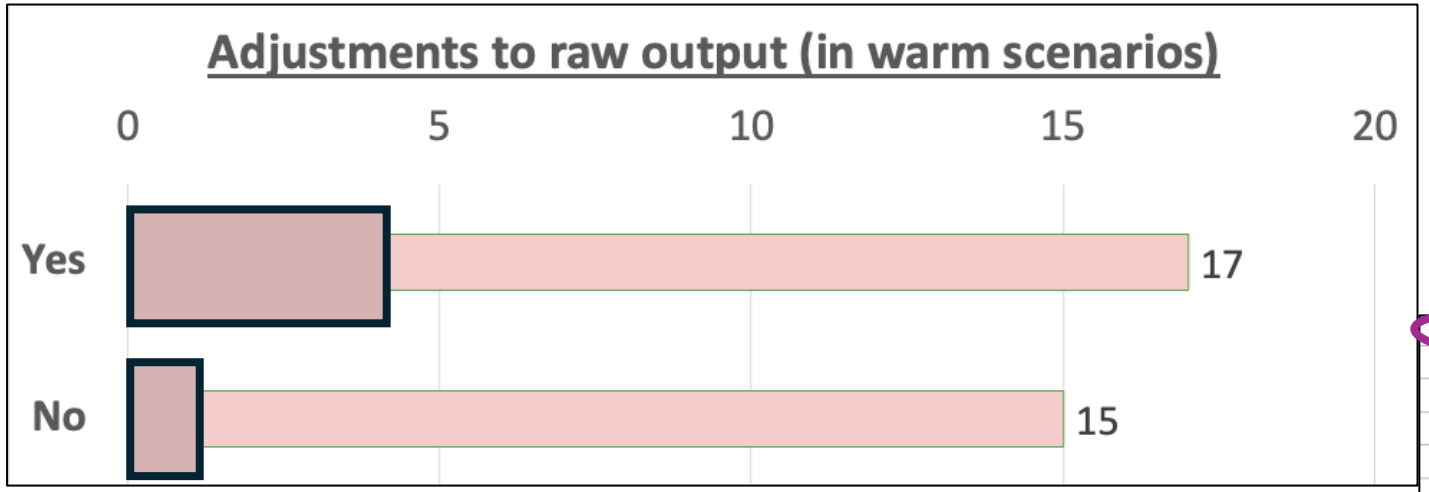



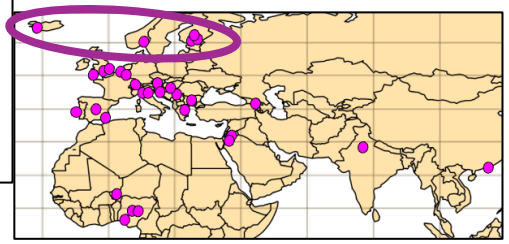
# When faced with the possibility of extreme temperatures do you make…

Norway, Finland, Iceland




Norway, Finland, Iceland

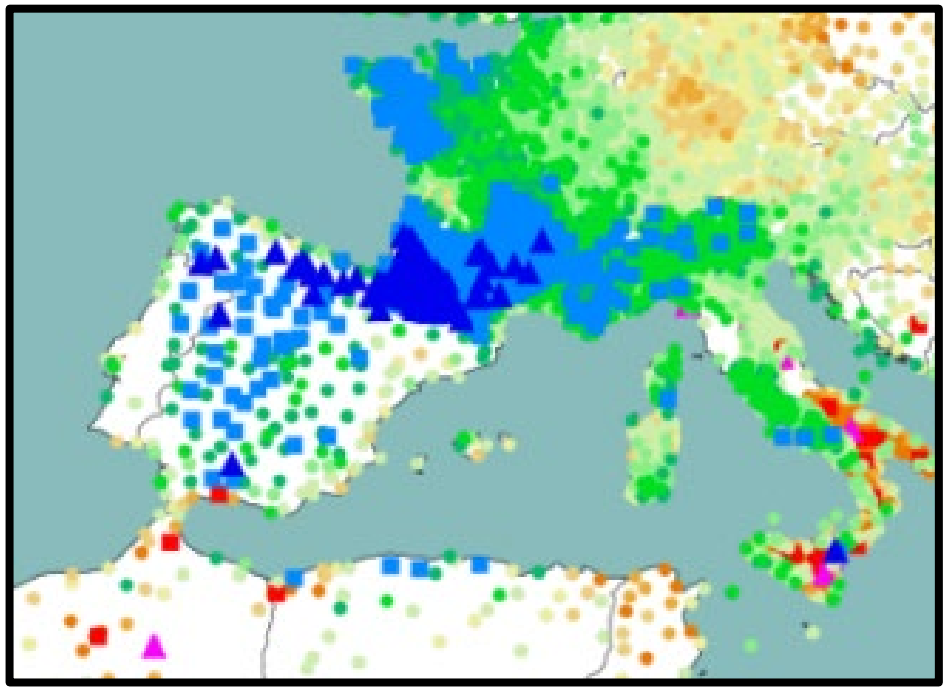


# Forecast Quality for extreme heat, and adjustments made

- Forecasts of extreme heat are seen as usable, but not consistently strong enough in all local settings.

- The main reasons for adjustments:
  - Altitude/elevation
  - Urbanisation
  - Soil and surface conditions
  - Known biases
  - Mapping onto local climatology
  - Differences in Multi-model guidance



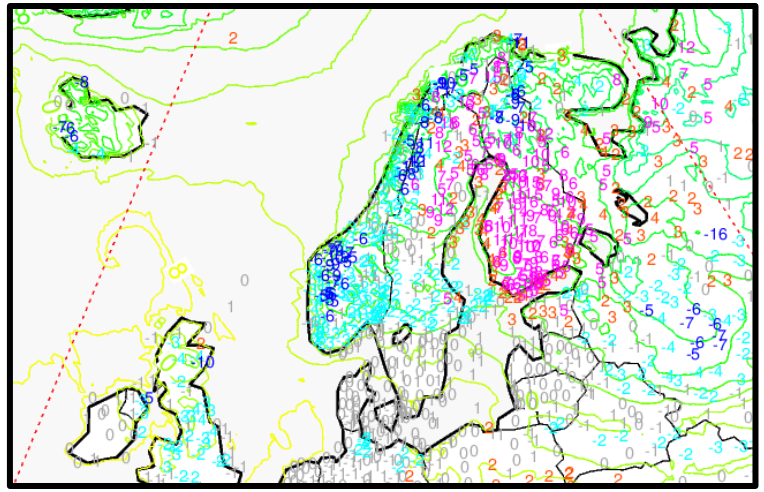
# Forecast Quality for extreme cold, and adjustments made

- Feedback suggests extreme cold remains a weaker area, especially in inversion and snow-cover cases

- The main reasons for adjustments:
  - Inversion strength
  - Snow cover
  - Known frost hollows / local cold-pooling effects
  - Low cloud
  - Terrain impacts
  - Local forecasting expertise

*“ Winter-time 2m temperature errors can be as much as 15-20C (too warm). Often because of too much low cloud ”*

*“ XGBoost-based bias correction of 2m temperature under development ”*



# Main challenges in forecasting extreme heat/cold

- The biggest recurring challenges relate to **local effects** from:
  - Topography / valleys
  - Coastlines
  - Urbanisation / cities
  - Snow cover
  - Soil moisture
  - Land-atmosphere interactions in general

Resolution

Model Physics

Post-processing

Observations

- General issues were:
  - Low cloud
  - Inversions
  - Timing / duration / intensity of extremes

- The following also presented challenges:
  - Model resolution limitations
  - Communicating uncertainty at longer lead times

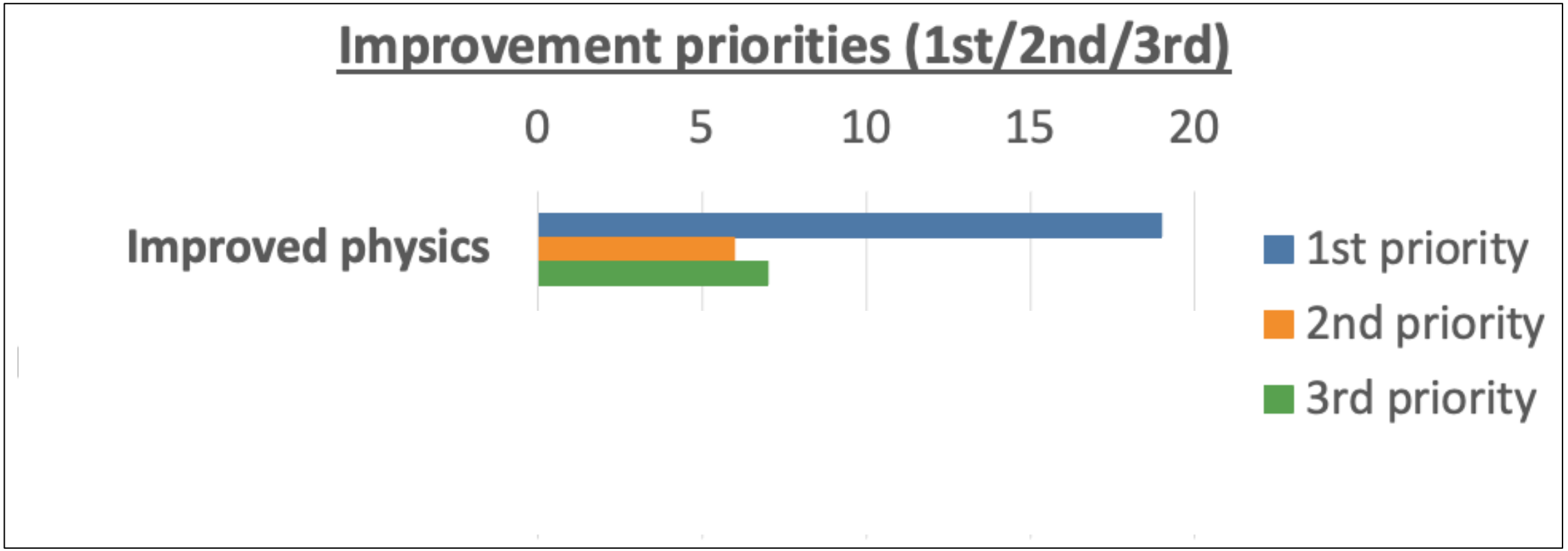
*“ Extreme highs are manually increased, extreme lows are manually decreased ”*

*“ Maybe physics is not the way to improve 2m temperature ” (Finland comment)*

*“ Dry air makes errors bigger ”*

*“ maximum daytime temperatures during heatwave conditions, as well as persistently high night-time temperatures, are particularly important because both have significant impacts on agriculture, human health, water stress, and vulnerable populations ”*

# Prioritise methods for improving extreme temperature forecasts…



*Valley and mountain temperatures are a key problem area for ECMWF users.*
*How might we address this with post-processing ?*

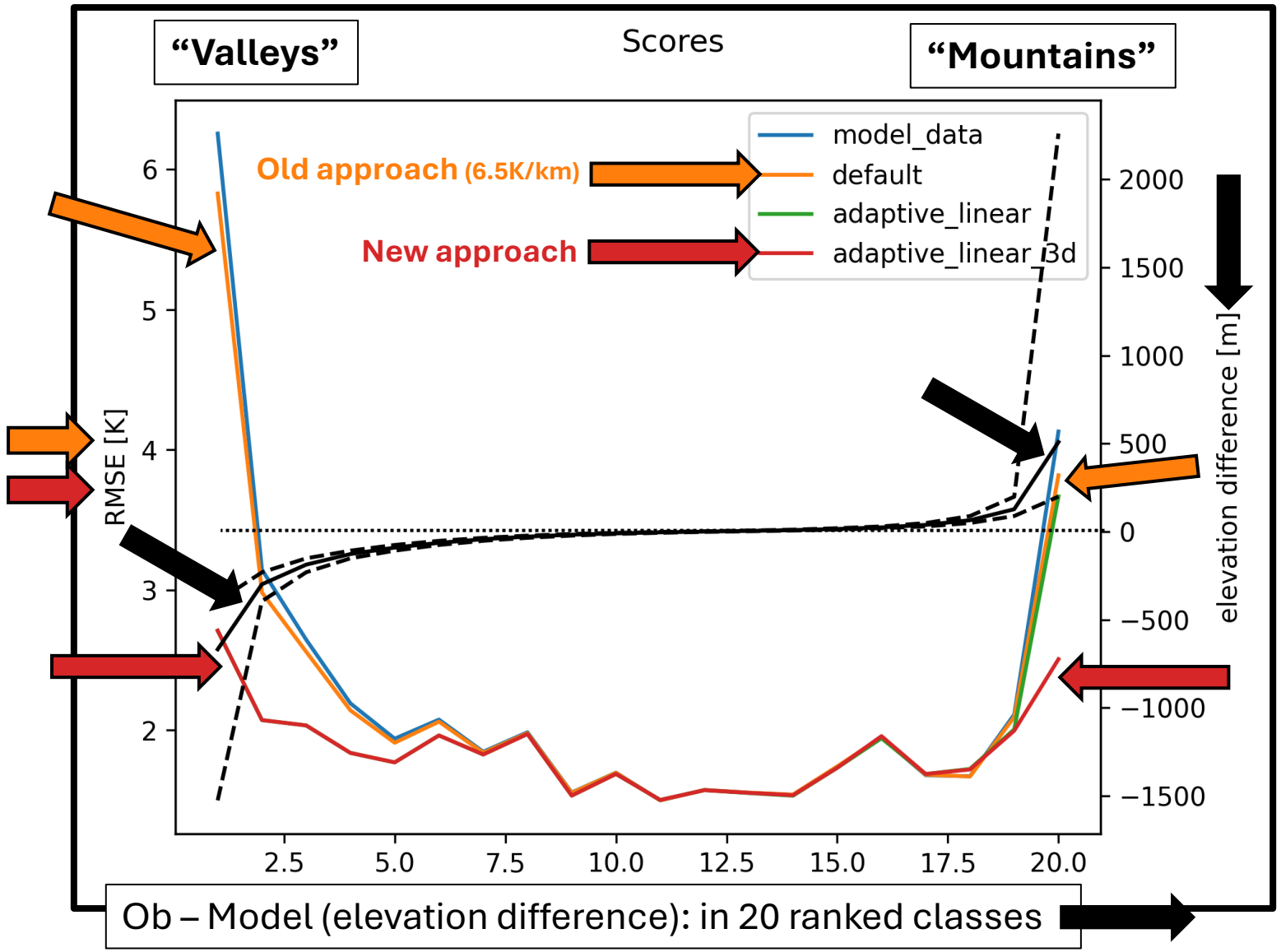
# Temperature Adjustment for Altitude – e.g for Meteograms

- Lapse rate (L) of -6.5K/km currently always assumed at ECMWF for IFS-based products
- Not so bad for most cases, but can be very bad in e.g. winter-time inversion situations
  - +100K/km quite possible then in reality!
- Big issues in e.g. Alps
- But notable errors also possible, occasionally, where there are (say) hills < 300m high

- We can do better by using a variable lapse rate, based on dynamic local computations (correlating $T_{2m}$ with $H_{model}$ within an x-y plane ring)
  - This is equivalent to using the instantaneous, local, $T_{2m}$ lapse rate on the model's 2m surface
  - In this approach we would not, generally, reference any model level data

*Links to work by Vosper et al at the UK Met Office*

# Example, for Europe, of 2m Temp Errors on a summer afternoon



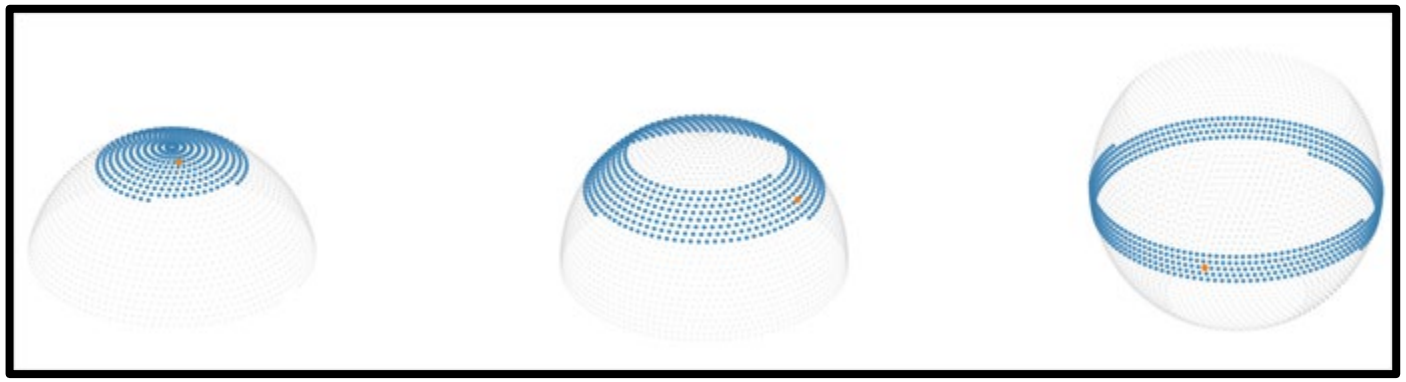

- Big error reductions for valley and mountain sites, compared to current 6.5K/km approach

Working together in a collaborative project with e.g. a member state, ECMWF could push these concepts forward into operations

See Höhlein et al (2024) (Arxiv)

# 7. AI models

*“ What improvements would you most like to see in the AIFS (Single and ENS)? For example, products, resolution, or performance in specific areas. Please explain your answer. ”*



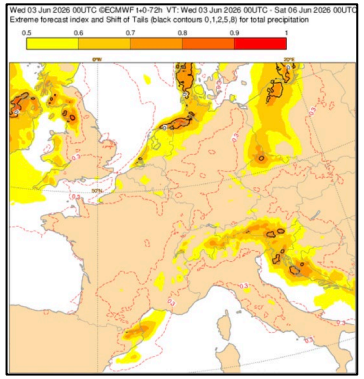
# AIFS wish list

- Most commonly requested:
  - Higher spatial resolution
  - Higher temporal resolution
- Stronger performance for:
  - Extremes
  - Convective precipitation
  - Wind gusts
  - Precipitation type
  - Local terrain-dependent effects
- Also wanted:
  - Broader product suite, including EFI-like tools
  - More ways to compare with IFS
  - Outputs more suitable for operational use (?)

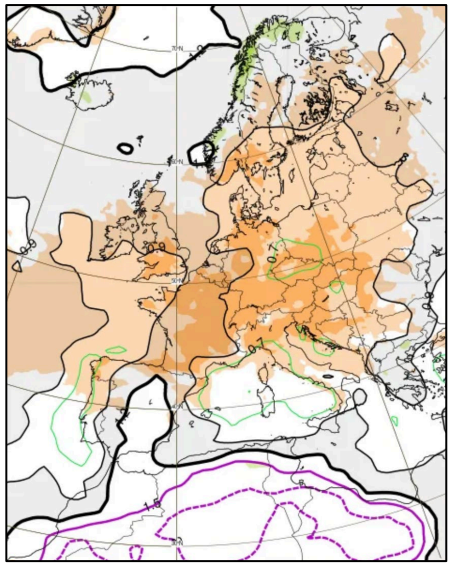
*“ Most forecast value (impact-wise) is concentrated in rare events, not mean state improvements ”*

*“ It may also be that some forecasting tools and outputs cannot be easily replicated in AI models ” (topic for discussion!)*

*“ How do AI models represent physical processes wrt (unseen) extremes? ”*



*“ Want the AIFS to deliver more for longer ranges ”*



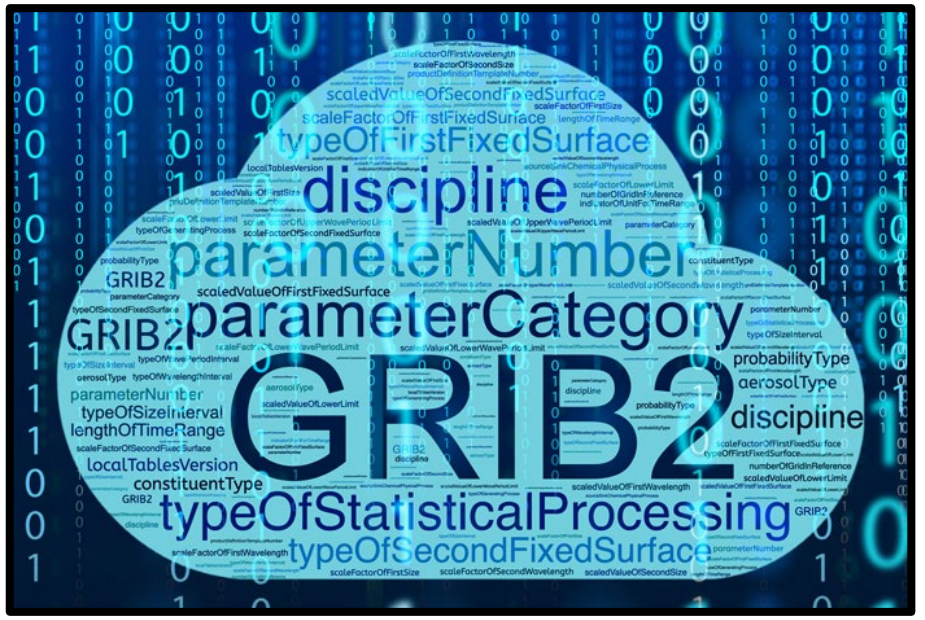
# 8. The transition to GRIB2

Note:

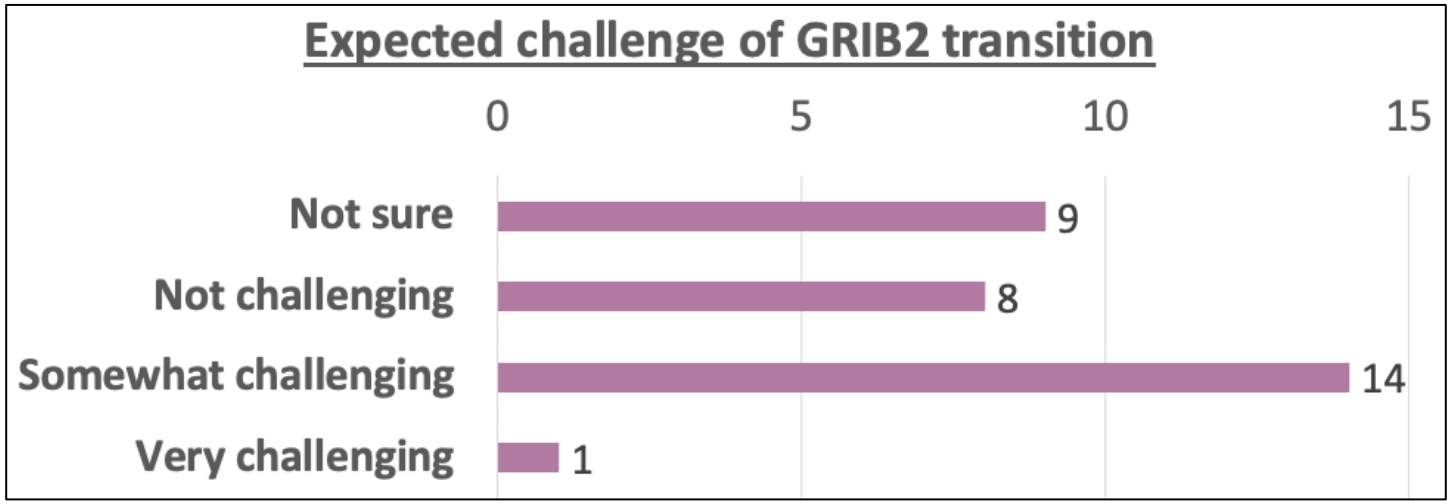
*GRIB2 Presentation and Q & A*

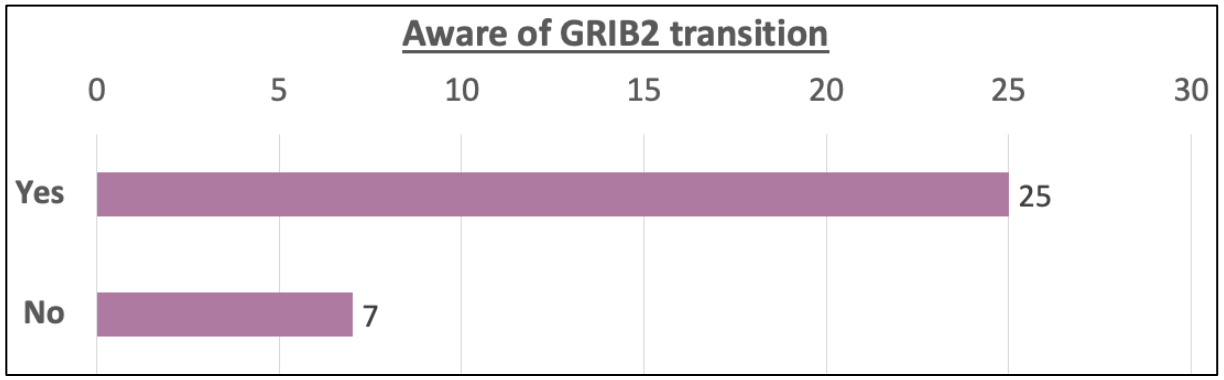
*Sebastien Villaume*

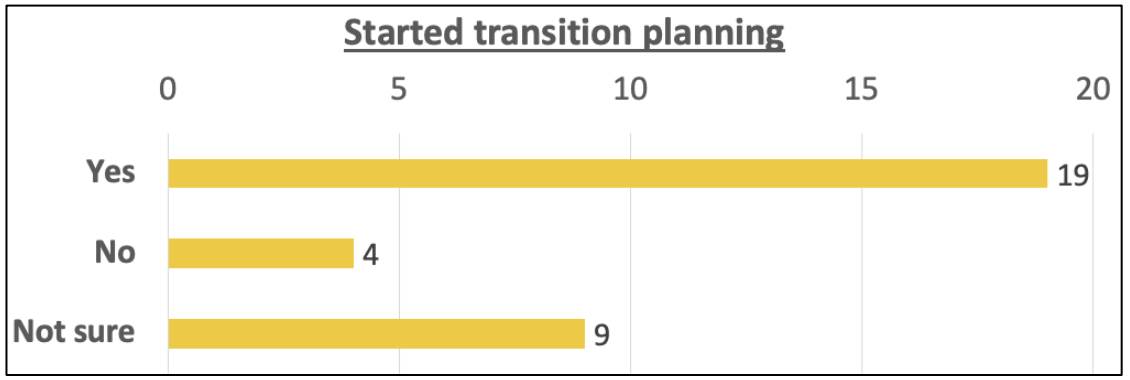
*Thu:  9.30 – 10.20*



# Managing the transition to GRIB2…



# Challenges for Users, and Help from ECMWF

- What do you anticipate to be the main challenges with this GRIB2 transition?
  - Updating scripts, post-processing chains, legacy routines and automated workflows without breaking service continuity.
  - Testing across full pipelines
  - Integrating with regional models or local systems
  - Storage/conversion issues
  - Limited technical capacity
  - Lack of staff time

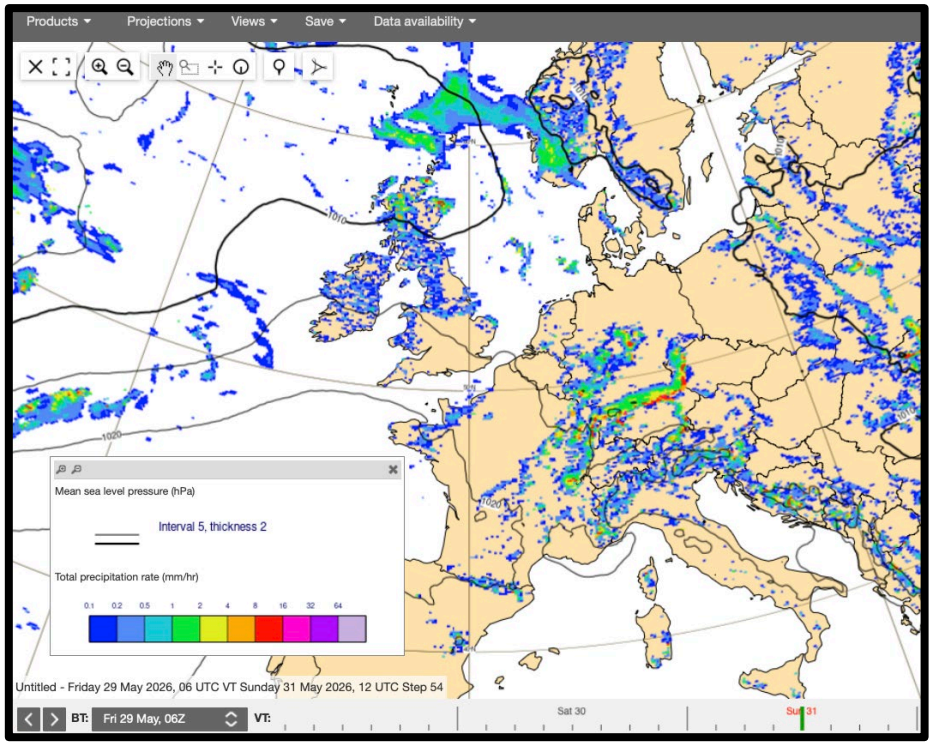
- What can ECMWF do to help ?
  - Clear documentation
  - Early communication of changes
  - Early access to test data/examples
  - Provision of transitional tools
  - Backward-compatible options
  - Training and practical guidance

# 9. Miscellaneous comments (i)

- Praise for:
  - ECMWF output quality
  - Early delivery
  - Community engagement
  - Useful visual products
  - Hurricane forecasts

- Requests:
  - Better ecCharts usability
  - More product variety
  - More downscaling/local relevance

- Support for:
  - ECMWF's AI and Medium-range developments

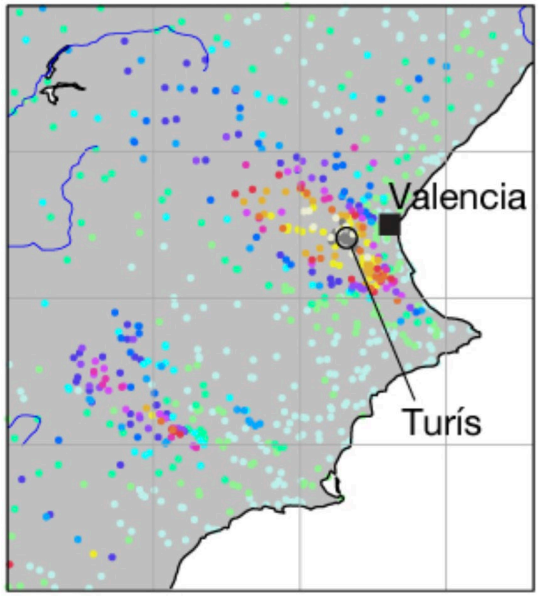


# 9. Miscellaneous comments (ii)

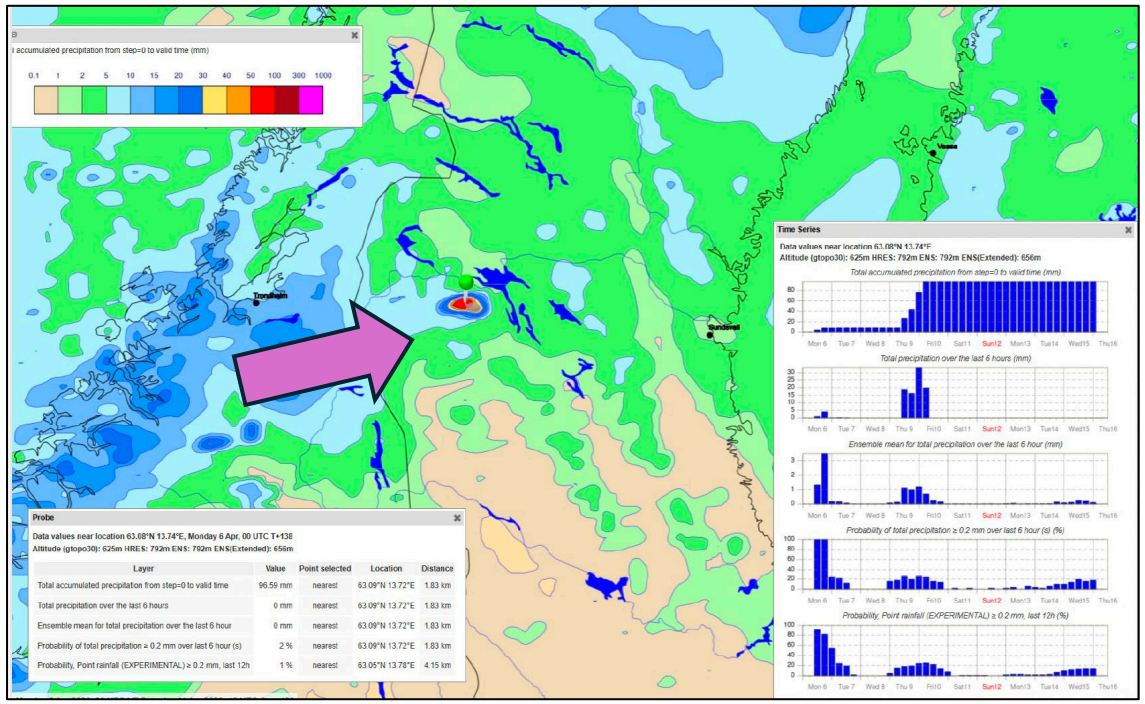
- Local rules for heat health warnings (presumably cold also) – vary greatly
  - ➢ Hard for ECMWF to cover all the bases, but we do deliver a wide range of *Thermofeel* products

- " For TCs we use AIFS for their tracks and IFS for their intensities "
  - ➢ Nice approach, provided some consistency checks applied (e.g. to avoid very extreme well inland)

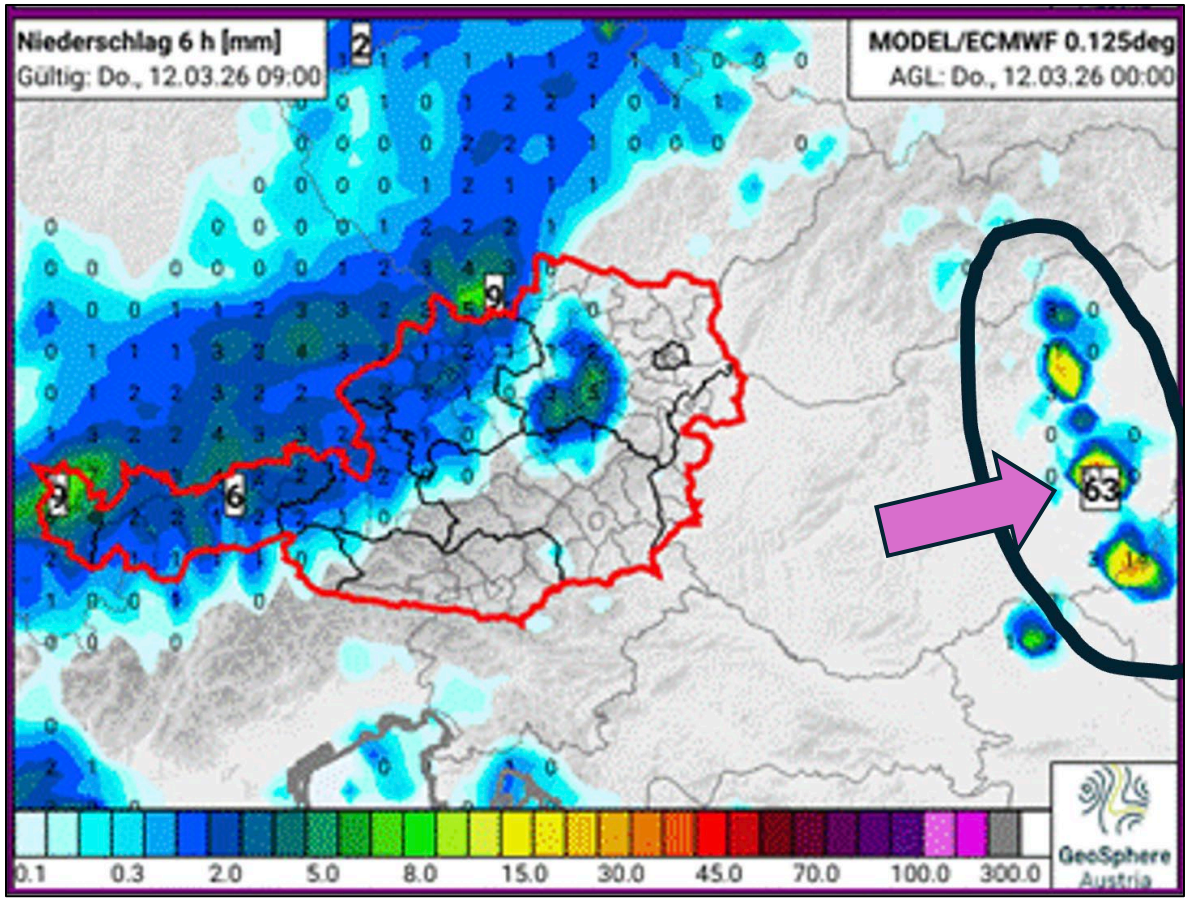
- ecPoint comments:
  - Quite good for Atlantic Basin
  - Poor for Mediterranean Basin
  - Very useful, practical, high quality (N Italy)
  - ➢ ecPoint substantially updated with 50r1 (ref: weather station from Tue afternoon)



# 10. Examples




**Rainbomb in Sweden**




**Spurious development of night-time convection in Hungary 2x**

| | |
|---|---|
| P13. Occasional convective rainfall "bullseyes" | Sin<br>loca<br>mer<br>kno |

Covered in “Known Forecast Issues” – ECMWF Forecast User Portal
https://confluence.ecmwf.int/display/FCST/Known+IFS+forecasting+issues

# Breakout Groups

The purpose of these is as follows (in rough priority order):

- To allow users to ask specific questions of staff who are likely to know the answers. Topics can be technical, meteorological, product-related, etc: pretty much anything related to 'using ECMWF forecasts'.
- To allow users to raise any concerns they have - e.g. about recurring model issues, product issues, a badly forecast event, ECMWF strategy, data delivery problems, ...
- To have discussion and debate on topics related to the breakout group theme
- For ECMWF staff to ask users specific questions that we would like to hear answers to
- Anything else that seems appropriate!

- Breakout group topics were selected based on survey results and on current topical areas

| Topic | Location | ECMWF staff |
|---|---|---|
| **“Land Surface Processes and 2m Temperature”** | **Classroom** *(between weather room and restaurant)* | Patricia de Rosnay / Gabriele Arduini / Annelize van Niekerk |
| **“New ECMWF Model Versions: 50r1 and AIFS V2s”** | **Lecture Theatre** *(stay here!)* | Inna Polichtchouk / Phil Browne / Simon Lang / Milana Vuckovic |
| **“Extreme / Interesting Case Studies”** | **Large Committee Room** *(turn left through doors just outside lecture theatre, go upstairs – follow signs!)* | Linus Magnusson / Fernando Prates / Richard Forbes / Esti Gascon / Rebecca Emerton |
| **“How would you like to see ECMWF products evolve in future”** | **Weather Room** *(where posters were)* | Ivan Tsonevsky / Cihan Sahin / Matthieu Chevallier / Gabriel Moldovan |
| **"Technical / Data issues”** | **Council Chamber** *(leave lecture theatre, and it’s the big room to the left)* | Emma Pidduck / Tiago Quintino / Paul Dando / Michela Giusti |

**Feel free to circulate and visit more than one topic group !!!**

**Groups remain open until 5pm**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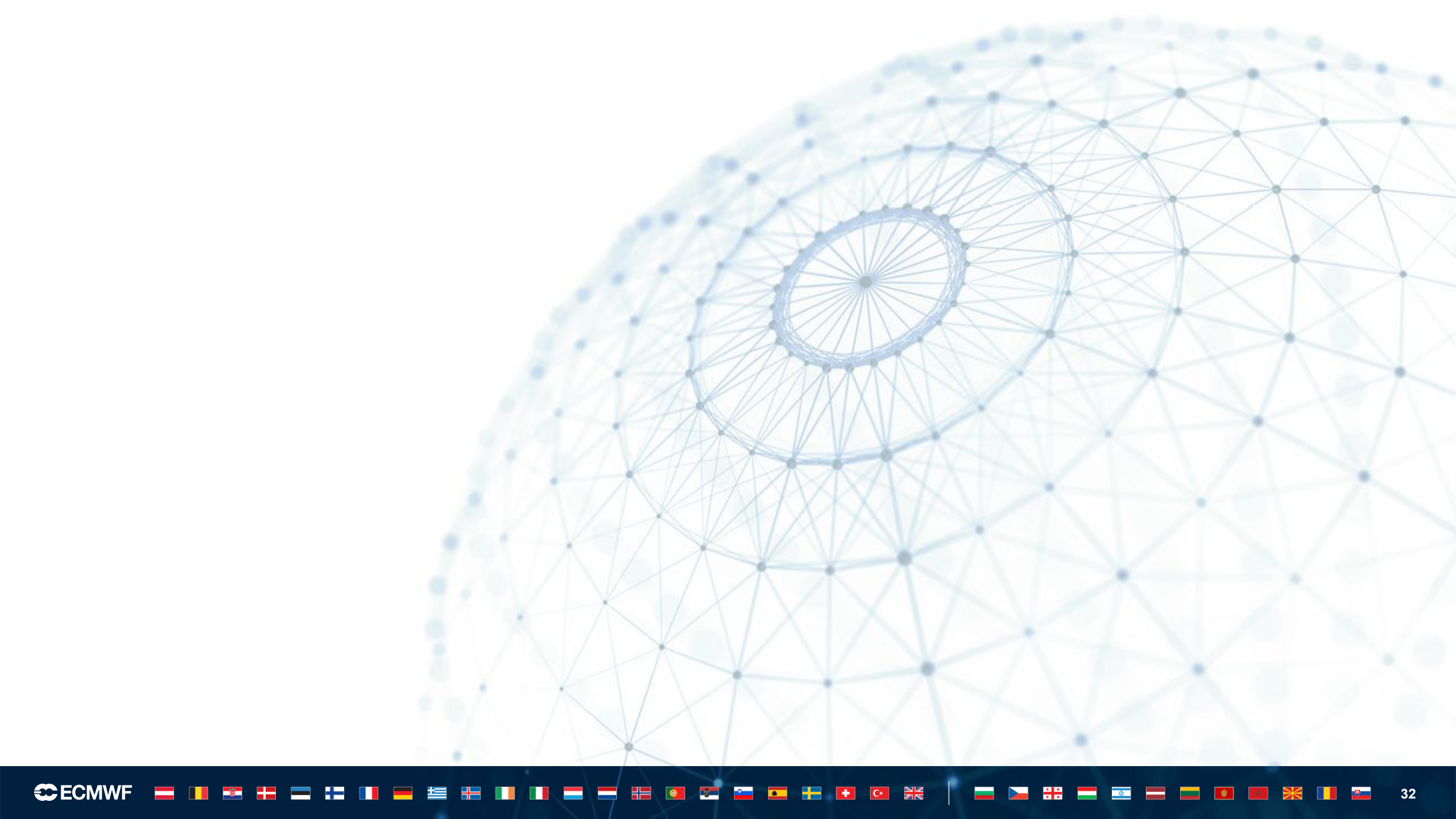
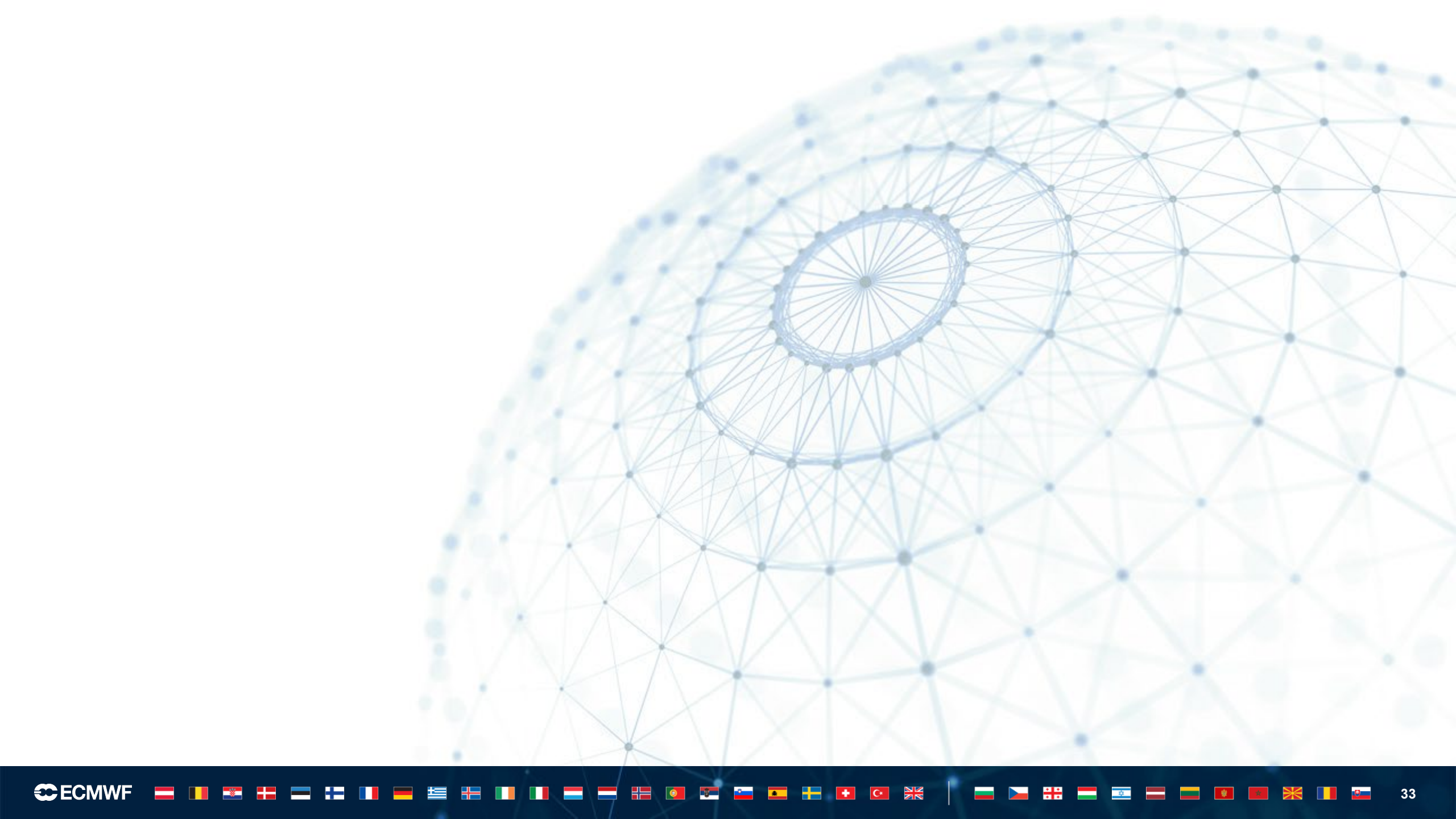
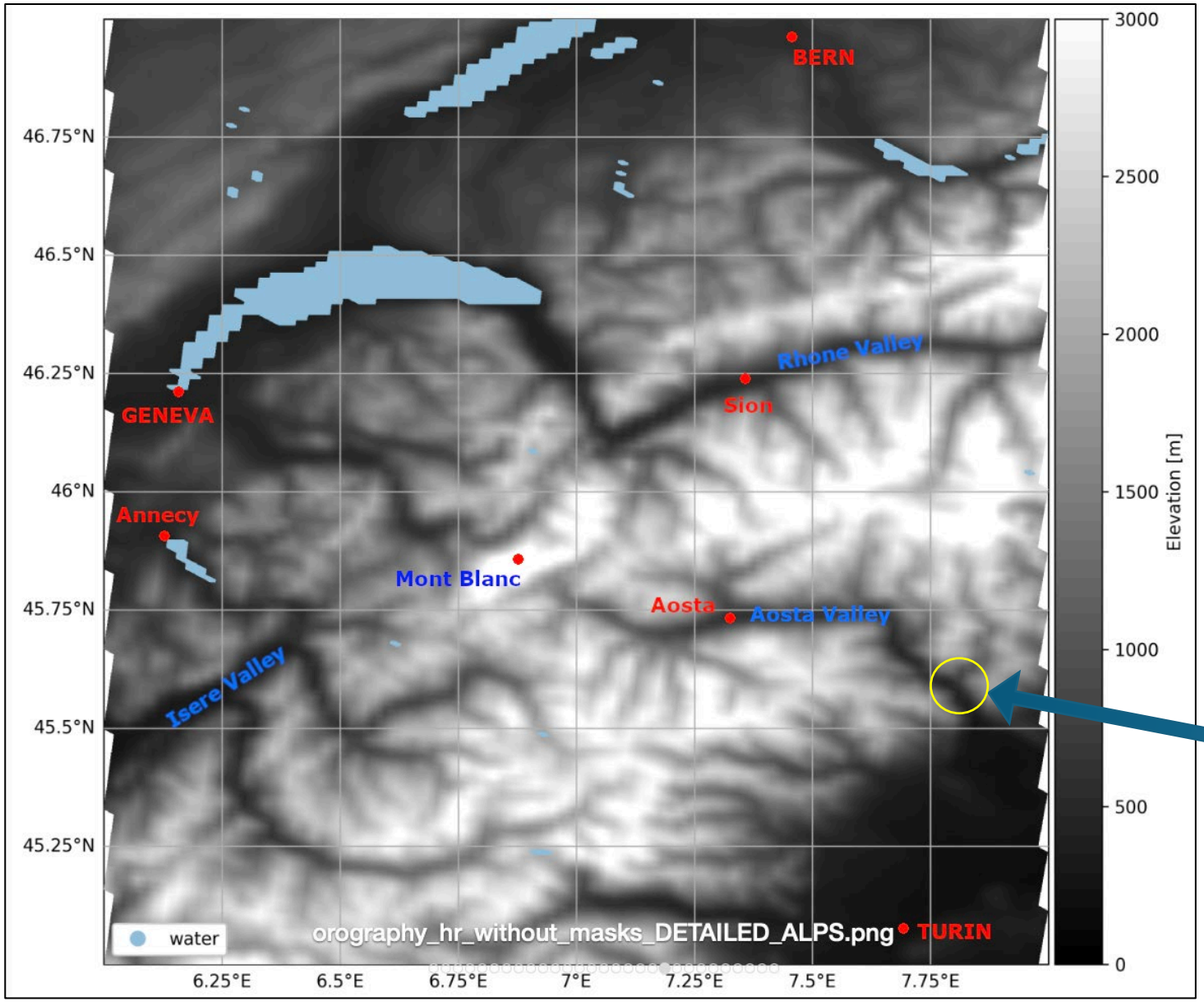




| | |
|---|---|
| 3. Forecasting aspects of most concern | • The most frequently cited priorities were temperature extremes, precipitation amount/type, cloud/fog, convection/lightning, wind, and severe weather.<br>• Many respondents highlighted ensemble and probabilistic products, EFI, and operational warning support.<br>• A recurring theme was the need to better capture local effects, complex terrain, coastal influences, and longer-range uncertainty. |
| 4. Problems experienced in the last 18 months | • Common issues were biases in minimum/maximum temperatures, especially during inversions, radiative nights, snow cover, and complex terrain situations.<br>• Several respondents noted cloud and low-cloud issues, plus convective precipitation/lightning problems such as unrealistic spots, poor placement, or underestimation.<br>• Some also mentioned medium-range consistency issues, storm evolution/timing problems, or ensemble tail reliability.<br>• A noticeable minority reported no major recent problems. |
| 5. Notably good forecasts | • Respondents generally felt ECMWF performs well for synoptic-scale situations, medium-range pattern recognition, and ensemble guidance.<br>• Positive examples included improved fog/low-cloud forecasting, useful EFI/ensemble products, good handling of some storms, tropical cyclone tracks, floods, and winter weather setups.<br>• A few respondents did not name a specific standout case, but still described overall performance as good. |
| 6a.i. Quality for extreme heat | • Ratings were mostly positive: 19 rated forecasts Good and 5 Very good.<br>• A smaller group rated performance Fair (5), while 2 were unsure.<br>• Overall, respondents see heat forecasts as usable, but not consistently strong enough in all local settings. |
| 6a.ii. Adjustments to raw output for extreme heat | • Views were evenly split: 16 respondents adjust raw output and 16 do not.<br>• Where adjustments are made, the main reasons are altitude/elevation effects, terrain, urban or local climatology, soil and surface conditions, and known warm/cold biases.<br>• Statistical correction, bias correction, and use of regional or multi-model guidance were common approaches. |
| 6b.i. Quality for extreme cold | • Cold forecasts were rated more cautiously than heat forecasts.<br>• 13 respondents rated them Good, 10 Fair, 1 Very good, 1 Poor, and 1 Very poor; 6 were unsure.<br>• The feedback suggests extreme cold remains a weaker area, especially in inversion and snow-cover cases. |
| 6b.ii. Adjustments to raw output for extreme cold | • Fewer respondents adjust raw output for cold than for heat, but a sizeable minority still do so (13 yes, 19 no).<br>• Typical adjustments focus on inversion strength, snow cover, frost hollows, low cloud, terrain, and local cold-pool effects.<br>• Statistical post-processing and local forecaster expertise are still important for cold extremes. |
| 6c. Priority ranking for improving extreme temperature forecasts | • Improved physics was the most common first priority (19 responses).<br>• Developing ML models further was also strongly supported and was the top choice for 9 respondents.<br>• Direct post-processing was most often seen as a lower-priority or more local solution, although 4 respondents ranked it first.<br>• Additional comments often argued for a combined approach rather than choosing a single path. |
| 6d. Main challenges in forecasting extreme heat/cold | • The biggest recurring challenge is representing local effects: topography, coastlines, cities, valleys, snow cover, soil moisture, and land-atmosphere interactions.<br>• Respondents also highlighted problems with low cloud, inversions, persistence, timing, and the duration/intensity of extremes.<br>• Limited model resolution and communicating uncertainty at longer lead times were also important themes. |
| 7. Desired AIFS improvements | • The clearest request was higher spatial resolution, often together with better temporal resolution.<br>• Respondents want stronger performance for extremes, convective precipitation, wind gusts, precipitation type, and local terrain-dependent effects.<br>• Many also asked for a broader product suite, including EFI-like tools, more diagnostics, better comparison with IFS, and outputs more suitable for operational use. |
| 8a. Awareness of the GRIB2 transition | • Awareness is high: 25 respondents said they are aware of the GRIB2 transition, while 7 said they are not. |
| 8b. Planning for the GRIB2 transition | • 19 organisations have started planning for the transition.<br>• 4 said they have not started, and 9 were unsure.<br>• This suggests awareness is strong, but preparedness is uneven across organisations. |
| 8c. Expected level of challenge from the GRIB2 transition | • Most expect the change to be manageable rather than severe.<br>• 14 described it as somewhat challenging, 8 as not challenging, 9 were unsure, and 1 expected it to be very challenging. |
| 8d. Main anticipated GRIB2 challenges | • The most common concerns were updating scripts, post-processing chains, legacy routines, and automated workflows without breaking service continuity.<br>• Respondents also mentioned testing across full pipelines, integrating with regional models or local systems, storage/conversion issues, and limited technical capacity or staff time. |
| 8e. Support requested from ECMWF for the GRIB2 transition | • The most requested support was clear documentation, early communication of changes, and access to test data/examples well in advance.<br>• Training, practical guidance, transitional tools, backward-compatible options, and early file access were also mentioned repeatedly. |
| 9. Annotated graphs / diagrams / plots | • Most respondents did not provide extra material and left this section blank or answered with N/A / no.<br>• A small number referenced screenshots or existing operational charts, but there was no strong common theme in uploaded supporting material. |
| 10. Additional comments | • Most respondents left no further comments.<br>• Where comments were added, they often praised ECMWF output quality, early delivery, community engagement, and useful visual products.<br>• Additional suggestions included better ecCharts usability, more product variety, more downscaling/local relevance, and continued support for AI and medium-range developments. |

| |
|---|
| **Some highlights. Many comments on temp-elevation corrections. Biases in light ppn. Surface impacts on 2m temp (errors). Concern aboiut using grib2 data to drive LAMs.** |
| not much |
| probs for extremes growing. Fog much better. False alarms for night time convection. Local Rules wrt heat warnings. |
| want AIFS at IFS resolution |
| cloud not enough given vertical RH structure. AIFS v good in a winter low cloud case. Manually increase extreme highs, reduce extreme lows; look at surface. Higher res AIFS, ppn type too. |
| winter low cloud bit better. Lapland low mins not low enough. Maybe phys not be way to improve 2t? Temporal res for daily min/max [no!]. |
| |
| better modelling of soil moisture depletion (heatwave impact). How do AI models represent physical procs wrt (unseen) extremes. More AI vs phys tools. |
| local topog accounted for wrt minima (frost hollows). |
| subseas poor last 2 winters (europe). AIFSens good autumn/early winter. |
| stress the importance of distribution tails for impact. Less interest in mean behaviour. Convective ppn totals (sub-daily) key |
| happy with hurricane forecasts from ECMWF |
| week 2 FC verification. Lightning variables verification. Near coast / high ground convective ppn overdone (50r1 fix). Winter 25/26 over-forecasting cold (but late Dec / early Jan good fcs). Coastal cities problematic for 2t. Are there things AI models will not be able to do? More wx params from AIFS. What should be the future balance between AI and Phys models? Want AIFS MJO & EFI. HRES/Comtrol change has been tricky. |
| rainfall totals (?) placement and amount issue (Nigeria). Yet to look at AIFS. |
| how long will heat last issue. Want netcdf. (ACMAD) |
| prep of sigwx charts |
| fraction of wet snow can be too high. Winter low cloud issues. Site-specific correctiokns applied for temps. Night time temps issues in urban. Higher res AIFS request. |
| Model problem: rain! Better instability/dust for AIFS. |
| renewables wind and solar/sev wx. AIFS res inrease (wind farms..). Want clear comms from EC on what they must do to accomodate grib2. |
| air traffic: convection details, icing, turbulence, fog. AIFS: copy IFS products. |
| BCs for LAMs. Med events in 2025 mostly well forecast. Extremes in urban areas - biggest challenge. AIFS- higher res. |
| notably bad: yes, seldom; notably good: yes, often. Seas and mtns affect extreme temps. Higher res for AIFS (eg. for mtn effects) |
| trento 500m ht diff versus IFS. AIFS wish: deliver more for longer ranges. |
| Finland: extremes temps not extreme enough; cold worse. Dry air makes errors bigger. Too much low cloud in winter. Lightning insuffiicent, worse further N. AIFS wishes: gusts, EFI. |
| everything of interest! |
| extreme heat in India key, with local effects. "maximum daytime temperatures during heatwave conditions, as well as persistent high nighttime temperatures, is particularly important because both have significant impacts on agriculture, human health, water stress, and vulnerable populations". AIFS wish: higher res, extreme day/night temps in heatwaves. |
| croatia ATC: MUCAPE too high mtns. Too little low cloud winter 25/26. Extreme wind fcs N Croatia excellent. Extreme temps not v relevamnt for avn. |
| N Italy: resolution-related issues. Po Valley maxs too low. Point rain v useful and practical (notably good). Lakes, urban, topog local influences for temp extremds. AIFS higher res. |
| Mokwa flood in 2025 - EC forecasts good. Topog influences. AIFS wish - temps after storms. GRIB2 - train us! |
| Finland: 27 Dec windstorm 10kt deficit in FC winds, stability too high. Jumpy weekly FCs. AIFS often beats IFS. Xgboost-based bias correction of 2t developing. Inversion fc issue (wrt extreme T). Want grib2 dates fixed well ahead, with ecpds test data alongside! |
| HK: TCs AIFS for track, IFS for intensity. Point baed MOS for 2t. PP needs dense local networks for calibration, so not best for EC (but ecpoint?). Please minimise disruptive changes in future (eg upgrading resolution). |
| Convective ppn offshore not moving inland. Amy FC good. Inversions problematic. Topog-res issues. AIFS wishes: res/EFI. |
| Spain: Foehn 2t underdone. Big underestimes of autumn convective ppn. Heavy ppn near coast should be on mtns. Ecpoint bad in med basin/ok in Atlantic basin. Atmos river events better. 1km T downscaling. AIFS wish: higher res, ob integration for short-term, better extreme convective rainfall, match IFS products. |

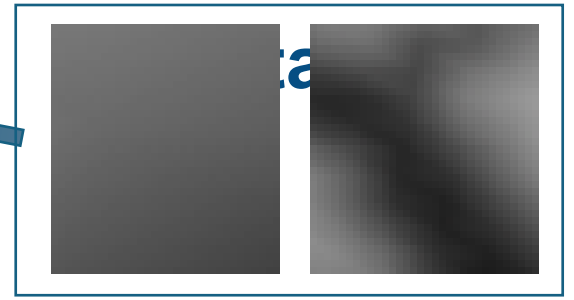



# Orography Example

## Western Alps

## ECMWF IFS (9km) versus 1km

model gridbox fine-scale



$T_{fine\text{-}scale} = T_{model} + (L^{*}\triangle z)$